2 **(a)** The equation of state for an ideal gas may be expressed as

$$pV = NkT.$$

(i) State the meaning of each of the symbols in this equation.

p: .....

V: .....

N: .....

k: .....

T: .....

[3]

(ii) Using the equation of state, derive an expression for the average translational kinetic energy E_K of a particle in the gas in terms of some or all of N, k and T.

E_K = ... [2]

(b) A molecule of hydrogen gas consists of two hydrogen atoms, each of nucleon number 1. A molecule of oxygen gas consists of two oxygen atoms, each of nucleon number 16.

Assume that hydrogen and oxygen both behave as ideal gases.

A sample of hydrogen gas is at the same temperature as a sample of oxygen gas.

For the two samples, determine the ratio

$$\frac{\text{root-mean-square (r.m.s.) speed of hydrogen molecules}}{\text{root-mean-square (r.m.s.) speed of oxygen molecules}}.$$

ratio = ... [2]

[Total: 7]